Internet Protocol television

Internet Protocol television (**IPTV**), also called **TV over broadband**,[1][2] is the service delivery of television over Internet Protocol (IP) networks. Usually sold and run by a telecom provider, it consists of broadcast live television that is streamed over the Internet (multicast) — in contrast to delivery through traditional terrestrial, satellite, and cable transmission formats — as well as video on demand services for watching or replaying content (unicast).[3]

An IPTV set-top box connected to a TV set, designed to receive television from a service called Mview

IPTV broadcasts started gaining usage during the 2000s alongside the rising use of broadband-based internet connections.[2] It is often provided bundled with internet access services by ISPs to subscribers and runs in a closed network.[4] IPTV normally requires the use of a set-top box, which receives the encoded television content in the MPEG transport stream via IP multicast, and converts the packets to be watched on a TV set or other kind of display.[3] It is distinct from over-the-top (OTT) services, which are based on a direct one-to-one transmission mechanism.

IPTV methods have been standardised by organisations such as ETSI.[5][6] IPTV has found success in some regions: for example in Western Europe in 2015, pay IPTV users overtook pay satellite TV users.[7] IPTV is also used for media delivery around corporate and private networks.

Definition

Historically, many different definitions of IPTV have appeared, including elementary streams over IP networks, MPEG transport streams over IP networks and a number of proprietary systems. One official definition approved by the International Telecommunication Union focus group on IPTV (ITU-T FG IPTV) is:

> IPTV is defined as multimedia services such as television/video/audio/text/graphics/data delivered over IP-based

> networks managed to provide the required level of quality of service and experience, security, interactivity and reliability.[8]

Another definition of IPTV, relating to the telecommunications industry, is the one given by Alliance for Telecommunications Industry Solutions (ATIS) IPTV Exploratory Group in 2005:

> IPTV is defined as the secure and reliable delivery to subscribers of entertainment video and related services. These services may include, for example, Live TV, Video On Demand (VOD) and Interactive TV (iTV). These services are delivered across an access agnostic, packet switched network that employs the IP protocol to transport the audio, video and control signals. In contrast to video over the public Internet, with IPTV deployments, network security and performance are tightly managed to ensure a superior entertainment experience, resulting in a compelling business environment for content providers, advertisers and customers alike.[9]

History

Up until the early 1990s, it was not thought possible that a television programme could be squeezed into the limited telecommunication bandwidth of a copper telephone cable to provide a video-on-demand (VOD) television service of acceptable quality, as the required bandwidth of a digital television signal was around 200 Mbit/s, which was 2,000 times greater than the bandwidth of a speech signal over a copper telephone wire. VOD services were only made possible as a result of two major technological developments: motion-compensated DCT video compression and asymmetric digital subscriber line (ADSL) data transmission.[10] Motion-compensated DCT algorithms for video coding standards include the H.26x formats from 1988 onwards and the MPEG formats from 1991 onwards.[11][12] Motion-compensated DCT video compression significantly reduced the amount of bandwidth required for a television signal, while at the same time ADSL increased the bandwidth of data that could be sent over a copper telephone wire. ADSL increased the bandwidth of a telephone line from around 0.1 Mbit/s to 2 Mbit/s, while DCT compression reduced the required bandwidth of a digital television signal from around 200 Mbit/s down to about 2 Mbit/s. The combination of DCT and ADSL technologies made it possible to practically implement VOD services at around 2 Mbit/s bandwidth in the 1990s.[10]

The term IPTV first appeared in 1995 with the founding of Precept Software by Judith Estrin and Bill Carrico. Precept developed an Internet video product named *IP/TV*. IP/TV was an Mbone compatible Windows and Unix-based application that transmitted single and multi-source audio

and video traffic, ranging from low to DVD quality, using both unicast and IP multicast Real-time Transport Protocol (RTP) and Real time control protocol (RTCP). The software was written primarily by Steve Casner, Karl Auerbach, and Cha Chee Kuan. Precept was acquired by Cisco Systems in 1998.[13] Cisco retains the IP/TV trademark.

Telecommunications company US West (later Qwest) launched an IPTV service called TeleChoice in Phoenix, Arizona in 1998 using VDSL technology, becoming the first company in the United States to provide digital television over telephone lines.[14][15] The service was shut down in 2008.[16]

Internet radio company AudioNet started the first continuous live webcasts with content from WFAA-TV in January 1998 and KCTU-LP on 10 January 1998.[17]

Kingston Communications, a regional telecommunications operator in the UK, launched Kingston Interactive Television (KIT), an IPTV over digital subscriber line (DSL) service in September 1999. The operator added additional VOD service in October 2001 with Yes TV, a VOD content provider. Kingston was one of the first companies in the world to introduce IPTV and IP VOD over ADSL as a commercial service. The service became the reference for various changes to UK Government regulations and policy on IPTV. In 2006, the KIT service was discontinued, subscribers having declined from a peak of 10,000 to 4,000.[18][19]

In 1999, NBTel (now known as Bell Aliant) was the first to commercially deploy Internet protocol television over DSL in Canada[20] using the Alcatel 7350 DSLAM and middleware created by iMagic TV (owned by NBTel's parent company Bruncor[21]). The service was marketed under the brand VibeVision in New Brunswick, and later expanded into Nova Scotia in early 2000[22] after the formation of Aliant. iMagic TV was later sold to Alcatel.[23]

In 2002, Sasktel was the second in Canada to commercially deploy IPTV over DSL, using the Lucent Stinger DSL platform.[24]

In 2005, SureWest Communications was the first North American company to offer high-definition television (HDTV) channels over an IPTV service.[25]

In 2005, Bredbandsbolaget launched its IPTV service as the first service provider in Sweden. As of January 2009, they are not the biggest provider any longer; TeliaSonera, who launched their service later, now has more customers.[26]

In 2007, TPG launched their IPTV service in Australia after a limited beta.[27][28] By 2010, iiNet and Telstra launched IPTV services in conjunction to internet plans.[29]

In 2008, Pakistan Telecommunication Company Limited (PTCL) launched IPTV under the brand name of PTCL Smart TV in Pakistan. This service is available in 150 major cities of the country

offering 140 live channels.

In 2010, CenturyLink – after acquiring Embarq (2009) and Qwest (2010) – entered five U.S. markets with an IPTV service called Prism.[30] This was after successful test marketing in Florida. Later in 2010, Bell Canada (a major division, if not the largest division of BCE) announced it would begin offering residential and business/commercial customers in Montreal, Quebec and Toronto, Ontario IPTV over a number of different modalities, including fibre to the home, fibre to the node and DSL. This flavour of IPTV would be packaged with other services and branded as "Bell Fibe," providing Canadian customers with everything from local analogue trunk connectivity (POTS), to DSL and fibre Internet to TV service via IPTV.[31] Bell further announced in the September 13th (2010) press release it would begin deploying fiber optic Ethernet to homes in Montreal and Toronto. Bell has since continued to install fiber optic Ethernet to homes (fibre to the home) across Ontario and Quebec, Bell Canada's two largest customer territories. Bell was very successful with the deployment of the Bell Fibe product offering. Many customers in Ontario and Quebec switched from legacy (coaxial) cable companies to Bell's Fibe product because of Bell's marketing around IPTV and their at-home wireless PVR offering. Bell's wireless PVR would permit customers to place a TV anywhere they wanted - as long as they had a power outlet. Bell Fibe TV commercials would show young families watching TV outside on the couch with large 70+ inch LCDs and their Bell Fibe wireless PVR.[32]

In Brazil, since at least 2012, Vivo has been offering the service Vivo TV Fibra in 200+ cities where it has FTTH coverage (4Q 2020 data) . Since at least 2018, Oi has also been offering IPTV under its FTTH service "Oi Fibra". Also, several regional FTTH providers also offer IPTV along with FTTH internet services.

In 2016, Korean Central Television (KCTV) introduced the set-top box called Manbang, reportedly providing video-on-demand services in North Korea via quasi-internet protocol television (IPTV). Manbang allows viewers to watch five different TV channels in real-time, and find political information regarding the Supreme Leader and Juche ideology, and read articles from state-run news organizations.

Markets

Residential

An IPTV set-top box on display from a Taiwanese provider

The global IPTV market was expected to grow from 28 million subscribers at US$12 billion revenue in 2009 to 83 million and US$38 billion in 2013. Europe and Asia are the leading territories in terms of the overall number of subscribers. But in terms of service revenues, Europe and North America generate a larger share of global revenue, due to very low average revenue per user (ARPU) in China and India, the fastest growing (and ultimately, the biggest markets) is Asia.[33]

Deutsche Telekom Media Receiver 400 set-top box for an IPTV service in Germany

Services also launched in Bosnia and Herzegovina, Bulgaria, Pakistan, Canada, Croatia, Lithuania, Moldova, Montenegro, Morocco,[34] North Macedonia, Poland, Mongolia, Romania, Serbia, Slovenia,[35] the Netherlands,[36] Georgia, Greece, Denmark, Finland, Estonia, Czech Republic, Slovakia, Hungary,[37][38] Norway, Sweden, Iceland, Latvia, Turkey, Colombia, Chile and Uzbekistan.[39] The United Kingdom launched IPTV early and after a slow initial growth, in February 2009 BT announced that it had reached 398,000 subscribers to its BT Vision service.[40] A free IPTV service by the public broadcasters was launched in 2024 named Freely. Claro has launched their own IPTV service called "Claro TV". This service is available in several countries in which they operate, such as Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua. IPTV is just beginning to grow in Central and Eastern Europe and Latin America, and now it is growing in South Asian countries such as Sri Lanka, Nepal Pakistan and India.[41] but significant

plans exist in countries such as Russia. Kazakhstan introduced[42] its own IPTV services by the national provider Kazakhtelecom JSC[43] and content integrator Alacast under the "iD TV" brand in two major cities Astana and Almaty in 2009 and is about to go nationwide starting 2010. Australian ISP iiNet launched Australia's first IPTV with Fetch TV.[44]

In India, IPTV was launched by MTNL, BSNL and Jio in New Delhi, Mumbai and Punjab. APSFL is another IPTV provider in the state of Andhra Pradesh.

In Nepal, IPTV was first launched by NEW IT VENTURE CORPORATION called Net TV Nepal, the service can be accessed through its app, web app and Set-top boxes provided by local ISPs, another IPTV was started by Nepal Telecom called WOW Time in 2016 which can be accessed through its app.

In Sri Lanka, IPTV was launched by Sri Lanka Telecom (operated by SLT VisionCom) in 2008, under the brand name of PEO TV. This service is available throughout the country. Dialog TV has been available through the service since 2018.

In Pakistan, IPTV was launched by PTCL in 2008, under the brand name of PTCL Smart TV. This service is available in 150 major cities of the country.

In the Philippines, PLDT offers Cignal IPTV services as an add-on in certain ADSL and fiber optic plans.[45][46]

In Malaysia, various companies have attempted to launch IPTV services since 2005. Failed PayTV provider MiTV attempted to use an IPTV-over-UHF service but the service failed to take off. HyppTV was supposed to use an IPTV-based system, but not true IPTV as it does not provide a set-top box and requires users to view channels using a computer. True IPTV providers available in the country at the moment are Fine TV and DETV. In Q2 2010, Telekom Malaysia launched IPTV services through their fibre to the home product Unifi in select areas. In April 2010, Astro began testing IPTV services on TIME dotCom Berhad's high-speed fibre to the home optical fibre network. In December 2010, Astro began trials with customers in high-rise condominium buildings around the Mont Kiara area. In April 2011, Astro commercially launched its IPTV services under the tag line "The One and Only Line You'll Ever Need", a triple play offering in conjunction with TIME dotCom Berhad that provides all the Astro programming via IPTV, together with voice telephone services and broadband Internet access all through the same fibre optic connection into the customer's home. In 2020, Astro launched "Plug-and-Play", which uses Unicast technology for streaming TV.

In Turkey, TTNET launched IPTV services under the name IPtivibu in 2010. It was available in pilot areas in the cities of Istanbul, İzmir and Ankara. As of 2011, IPTV service is launched as a large-scale commercial service and widely available across the country under the trademark

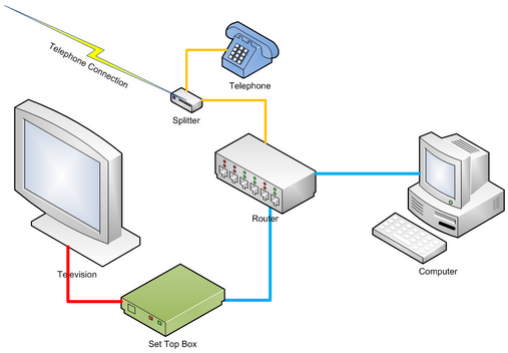
"Tivibu EV".[47][48] Superonline plans to provide IPTV under the different name "WebTV" in 2011. Türk Telekom started building the fibre optic substructure for IPTV in late 2007.

Commercial and corporate

IPTV has been widely used since around 2002 to distribute television and audio-visual (AV) media around businesses and commercial sites, whether as live TV channels or Video on Demand (VOD). Examples of types of commercial users include airports, schools, offices, hotels, and sports stadiums, to name just a few.

Hotel television systems are the in-suite television content presented in hotel rooms, other hotel environments and in the hospitality industry for in-room entertainment, as well as hospitals, assisted living, senior care and nursing homes. These services may be free for the guest or paid, depending on the service and the individual hotel's or hotel chain's policy. Generally, these services are controlled by using the remote control.

Architecture



A simplified network diagram for IPTV

Elements

An IPTV head-end is a place where live TV channels and AV sources are encoded, encrypted, and delivered as IP multicast streams. Meanwhile, a video on demand (VOD) platform stores on-demand video assets and serves them as IP unicast streams when a user requests them. Sometimes, the VOD platform is located within the IPTV head-end. An interactive portal allows users to navigate within the different IPTV services, such as the VOD catalogue. A delivery network is a packet-switched network that carries IP packets, including unicast and multicast streams. Endpoints refer to user equipment that can request, decode, and deliver IPTV streams for display to the user. This can include computers, mobile devices, and set-top boxes. At a residential IPTV user's home, the home TV gateway is the piece of equipment that terminates the access link from the delivery network. Lastly, the user set-top box is the piece of endpoint equipment that decodes and decrypts TV and VOD streams for display on the TV screen.

Architecture of a video server network

Depending on the network architecture of the service provider, there are two main types of video server architecture that can be considered for IPTV deployment: centralised and distributed.

The centralised architecture model is a relatively simple and easy-to-manage solution. Because all media content is stored in centralised servers, it does not require a comprehensive content distribution system. Centralised architecture is generally good for a network that provides relatively small VOD service deployment, has adequate core and edge bandwidth or has an efficient content delivery network (CDN).

A distributed architecture has bandwidth usage advantages and inherent system management features that are essential for managing a larger server network. Distributed architecture requires intelligent and sophisticated content distribution technologies to augment effective delivery of multimedia content over the service provider's network.[49]

Residential IPTV home networks

In many cases, the residential gateway that provides connectivity with the Internet access network is not located close to the IPTV set-top box. This scenario becomes very common as service providers start to offer service packages with multiple set-top boxes per subscriber.

Networking technologies that take advantage of existing home wiring (such as power lines, phone lines or coaxial cables) or of wireless hardware have become common solutions for this problem, although fragmentation in the wired home networking market has limited somewhat the growth in this market.[50][51]

In December 2008, ITU-T adopted Recommendation G.hn (also known as G.9960), which is a next-generation home networking standard that specifies a common PHY/MAC that can operate over any home wiring (power lines, phone lines or coaxial cables).[52]

Groups such as the Multimedia over Coax Alliance, HomePlug Powerline Alliance, Home Phoneline Networking Alliance, and Quasar Alliance (Plastic Optical Fibre)[53] each advocate their own technologies.

Telecomms IMS architecture

There is a growing standardisation effort on the use of the 3GPP IP Multimedia Subsystem (IMS) as an architecture for supporting IPTV services in telecommunications carrier networks. Both ITU-T and ETSI are working on so-called "IMS-based IPTV" standards (see e.g. ETSI TS 182

027[54]). Carriers will be able to offer both voice and IPTV services over the same core infrastructure and the implementation of services combining conventional TV services with telephony features (e.g. caller ID on the TV screen) will become straightforward.[55]

Protocols

IPTV supports both live TV as well as stored video-on-demand. Playback requires a device connected to either a fixed or wireless IP network in the form of a standalone personal computer, smartphone, touch screen tablet, game console, connected TV or set-top box. Content is compressed by Video and audio codecs and then encapsulated in MPEG transport stream or Real-time Transport Protocol or other packets. IP multicasting allows for live data to be sent to multiple receivers using a single multicast group address.

In standards-based IPTV systems, the primary underlying protocols used are:

- Service-provider-based streaming:
  - IGMP for subscribing to a live multicast stream (TV channel) and for changing from one live multicast stream to another (TV channel change). IP multicast operates within LANs (including VLANs) and across WANs also. IP multicast is usually routed in the network core by Protocol Independent Multicast (PIM), setting up correct distribution of multicast streams (TV channels) from their source all the way to the customers who wants to view them, duplicating received packets as needed. On-demand content uses a negotiated unicast connection. Real-time Transport Protocol (RTP) over User Datagram Protocol (UDP) or the lower overhead H.222 transport stream over Transmission Control Protocol (TCP) are generally the preferred methods of encapsulation.
- Web-based unicast only live and VOD streaming:
  - Adobe Flash Player prefers RTMP over TCP with setup and control via either AMF or XML or JSON transactions.
  - Apple iOS uses HLS adaptive bitrate streaming over HTTP with setup and control via an embedded M3U playlist file.
  - Microsoft Silverlight uses smooth streaming (adaptive bitrate streaming) over HTTP.
- Web-based multicast live and unicast VOD streaming:
  - The Internet Engineering Task Force (IETF) recommends RTP over UDP or TCP transports with setup and control using RTSP over TCP.
- Connected TVs, game consoles, set-top boxes and network personal video recorders:
  - Local network content uses UPnP AV for unicast via HTTP over TCP or for multicast live RTP over UDP.

- Web-based content is provided through either inline Web plug-ins or a television broadcast-based application that uses a middleware language such as MHEG-5 that triggers an event such as loading an inline Web browser using an Adobe Flash Player plug-in.

Local IPTV, as used by businesses for audio visual AV distribution on their company networks is typically based on a mixture of:

1. Conventional TV reception equipment and IPTV encoders
2. TV gateways that receive live Digital Video Broadcasting (DVB) MPEG transport streams (channels) from terrestrial aerials, satellite dishes, or cable feeds and convert them into IP streams

Via satellite

Although IPTV and conventional satellite TV distribution have been seen as complementary technologies, they are likely to be increasingly used together in hybrid IPTV networks. IPTV is largely neutral to the transmission medium, and IP traffic is already routinely carried by satellite for Internet backbone trunking and corporate VSAT networks.[56]

The copper twisted pair cabling that forms the last mile of the telephone and broadband network in many countries is not able to provide a sizeable proportion of the population with an IPTV service that matches even existing terrestrial or satellite digital TV distribution. For a competitive multi-channel TV service, a connection speed of 20 Mbit/s is likely to be required, but unavailable to most potential customers.[57] The increasing popularity of high-definition television increases connection speed requirements or limits IPTV service quality and connection eligibility even further.

However, satellites are capable of delivering in excess of 100 Gbit/s via multi-spot beam technologies, making satellite a clear emerging technology for implementing IPTV networks. Satellite distribution can be included in an IPTV network architecture in several ways. The simplest to implement is an IPTV-direct to home (DTH) architecture, in which hybrid DVB-broadband set-top boxes in subscriber homes integrate satellite and IP reception to give additional bandwidth with return channel capabilities. In such a system, many live TV channels may be multicast via satellite and supplemented with stored video-on-demand transmission via the broadband connection. Arqiva's Satellite Media Solutions Division suggests "IPTV works best in a hybrid format. For example, you would use broadband to receive some content and satellite to receive other, such as live channels".[58]

Hybrid IPTV

Hybrid IPTV refers to the combination of traditional broadcast TV services and video delivered over either managed IP networks or the public Internet. It is an increasing trend in both the consumer and pay TV markets.[59][60][61]

The growth of Hybrid IPTV is driven by two major factors. Since the emergence of online video aggregation sites, like YouTube and Vimeo in the mid-2000s, traditional pay TV operators have come under increasing pressure to provide their subscribers with a means of viewing Internet-based video on their televisions. At the same time, specialist IP-based operators have looked for ways to offer analogue and digital terrestrial services to their operations, without adding either additional cost or complexity to their transmission operations. Bandwidth is a valuable asset for operators, so many have looked for alternative ways to deliver these new services without investing in additional network infrastructures.

A hybrid set-top allows content from a range of sources, including terrestrial broadcast, satellite, and cable, to be brought together with video delivered over the Internet via an Ethernet connection on the device. This enables television viewers to access a greater variety of content on their TV sets, without the need for a separate box for each service. Hybrid IPTV set-top boxes may also enable users to access a range of advanced interactive services, such as VOD, catch-up TV, as well as Internet applications, including video telephony, surveillance, gaming, shopping, e-government accessed via a television set.

From a pay-TV operator's perspective, a hybrid IPTV set-top box gives them greater long-term flexibility to deploy new services and applications as and when consumers require, most often without the need to upgrade equipment or for a technician to visit and reconfigure or swap out the device. This reduces the cost of launching new services, increases speed to market and limits disruption for consumers.[62]

The Hybrid Broadcast Broadband TV (HbbTV) consortium of industry companies the establishment of an open European standard for hybrid set-top boxes for the reception of broadcast and broadband digital TV and multimedia applications with a single user interface.[63] These trends led to the development of Hybrid Broadcast Broadband TV set-top boxes that included both a broadcast tuner and an Internet connection – usually via an Ethernet port. The first commercially available hybrid IPTV set-top box was developed by Advanced Digital Broadcast, a developer of digital television hardware and software, in 2005. The platform was developed for Spanish pay TV operator Telefonica,[64] and used as part of its Movistar TV service, launched to subscribers at the end of 2005.

An alternative approach is the IPTV version of the Headend in the Sky cable TV solution. Here, multiple TV channels are distributed via satellite to the ISP or IPTV provider's point of presence (POP) for IP-encapsulated distribution to individual subscribers as required by each subscriber. This can provide a huge selection of channels to subscribers without overburdening incoming Internet to the POP, and enables an IPTV service to be offered to small or remote operators outside the reach of terrestrial high-speed WAN connection. An example is a network combining fibre and satellite distribution via an SES New Skies satellite of 95 channels to Latin America and the Caribbean, operated by IPTV Americas.[65]

Advantages

The Internet protocol-based platform offers significant advantages, including the ability to integrate television with other IP-based services like high-speed Internet access and VoIP.

A switched IP network also allows for the delivery of significantly more content and functionality. In a typical TV or satellite network, using broadcast video technology, all the content constantly flows downstream to each customer, and the customer switches the content at the set-top box. The customer can select from as many choices as the telecomms, cable or satellite company can stuff into the *pipe* flowing into the home. A switched IP network works differently. Content remains in the network, and only the content the customer selects is sent into the customer's home. That frees up bandwidth, and the customer's choice is less restricted by the size of the *pipe* into the home.

Interactivity

An IP-based platform also allows significant opportunities to make the TV viewing experience more interactive and personalised. The provider may, for example, include an interactive programme guide that allows viewers to search for content by title or actor's name, or a picture-in-picture functionality that allows them to channel surf without leaving the programme they're watching. Viewers may be able to look up a player's stats while watching a sports game or control the camera angle. They also may be able to access photos or music from their PC on their television, use a wireless phone to schedule a recording of their favourite show, or even adjust parental controls so their child can watch a documentary for a school report, while they're away from home.

A feedback channel from the viewer to the provider is required for this interactivity. Terrestrial, satellite, and some cable networks for television do not feature a feedback channel and thus don't allow interactivity. However, interactivity with those networks can be possible by combining TV networks with data networks such as the Internet or a mobile communication network.

Video on demand

IPTV technology is used for video on demand (VOD),[66] which permits a customer to browse an online programme or film catalogue, to watch trailers and to then select a program. The playout of the selected item starts nearly instantaneously on the customer's TV or PC.

Technically, when the customer selects the program, a point-to-point unicast connection is set up between the customer's decoder (set-top box or PC) and the delivering streaming server. The signalling for the trick mode functionality (pause, slow-motion, wind/rewind etc.) may be communicated using, for instance, RTSP.

In an attempt to avoid content piracy, the VOD content is usually encrypted and digital rights management may be applied. A film that is chosen, for example, may be playable for 24 hours following payment, after which time it becomes unavailable.

IPTV-based converged services

Another advantage is the opportunity for integration and convergence. This opportunity is amplified when using IMS-based solutions.[67] Converged services implies interaction of existing services in a seamless manner to create new value-added services. One example is on-screen caller ID, getting caller ID on a TV, and the ability to handle the call (send it to voice mail, etc.). IP-based services help to provide consumers anytime and anywhere access to content over their televisions, PCs, and mobile device, and to integrate services and content to tie them together. Within businesses and institutions, IPTV eliminates the need to run a parallel infrastructure to deliver live and stored video services.

Limitations

IPTV is sensitive to packet loss and delays. An IPTV channel has a minimum bandwidth requirement. Some systems are able to adapt to lower available bandwidth by reducing picture quality.

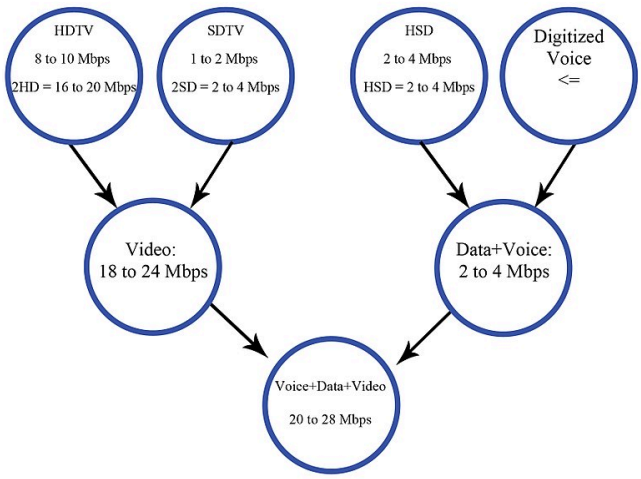
Although a few countries have very high-speed broadband-enabled populations,[a] in other countries legacy networks struggle to provide 3–5 Mbit/s[68] and so simultaneous use of IPTV, VOIP and Internet access may not be viable. The last-mile delivery for IPTV usually has a bandwidth restriction that only allows a small number of simultaneous TV channel streams – typically from one to three – to be delivered.[69]

Latency

The network delay inherent in the use of satellite Internet access is often held up as a reason why satellites cannot be successfully used for IPTV. In practice, however, delay is not an important factor for IPTV, since it is a service that does not require real-time transmission, as is the case with telephony or videoconferencing services. It is the delay of response to requests to change channel, display an EPG, etc. that most affects customers' perceived quality of service.

Existing video transmission systems of both analogue and digital formats already introduce known quantifiable delays. Existing DVB TV channels that simulcast by both terrestrial and satellite transmissions experience the same 0.25-second delay difference between the two services with no detrimental effect, and it goes unnoticed by viewers.

Bandwidth requirements



Bandwidth capacity for simultaneously two HDTV streams, two SD streams, additional to HSD and voice

Digital video is a sequence of digital images, called frames, each made up of pixels or picture elements. Three bytes are typically used to represent the colour of the high quality image.

Movies use 24 frames per second, North America television uses approximately 30 frames per second where the Europe television frame rate is 25 frames per second. Each digital video has dimensions width and height; SDTV is 720 × 480 pixels, HDTV uses up to 1920 × 1080 pixels.

For checking the bandwidth requirements, you need to dimension your IPTV service, such as defining number of SD and HD TV channels, number of planned subscribers, VOD and nPVR concurrency. Based on these, you can calculate required bandwidth on each DSL line, in access network and in core IP network.[70]

Privacy implications

Due to limitations in bandwidth, an IPTV channel is delivered to the user one at a time. Changing a channel requires requesting the head-end server to provide a different broadcast stream, much like VOD.[b] This could enable the service provider to accurately track each and every programme watched and the duration of watching for each viewer. In conjunction with regulatory differences between IPTV and cable TV, this tracking could pose a threat to privacy according to critics.[71] For IP multicast scenarios, since a particular multicast group (TV channel) needs to be requested before it can be viewed, the same privacy concerns apply.

Vendors

Some major telecoms vendors are active in this space, notably Accenture (Accenture Video Solution), Alcatel-Lucent (sometimes working with Movistar TV), Ericsson (notably since acquiring Tandberg Television), Huawei, NEC, PTCL Smart TV, Sri Lanka Telecom, Thomson, and ZTE, as are some IT houses, led by Microsoft. Miami-based AlphaOTT, Tokyo-based The New Media Group, Malaysian-based Select-TV, Oslo/Norway-based SnapTV, and California-based UTStarcom, Inc. also offer end-to-end networking infrastructure for IPTV-based services, and Hong Kong-based BNS Ltd. provides turnkey open platform IPTV technology solutions. Others include Movistar TV and PCCW.

Google Fiber offers an IPTV service in various US cities which includes up to 1 Gigabit-speed internet and over 290 channels depending on package via the fibre optic network being built out in Kansas City Kansas and Kansas City Missouri.

Many of these IPTV solution vendors participated in the biennial Multiservice Switching Forum Interoperability 2008 (GMI) event which was coordinated by the MultiService Forum (MSF) at five sites worldwide from 20 to 31 October 2008. Test equipment vendors including Netrounds, Codenomicon, Empirix, Ixia, Mu Dynamics, and Spirent joined solution vendors such as the companies listed above in one of the largest IPTV proving grounds ever deployed.

Service bundling

For residential users, IPTV is often provided in conjunction with VOD and may be bundled with Internet services such as Internet access and voice over Internet Protocol (VoIP) telecommunications services. Commercial bundling of IPTV, VoIP and Internet access is sometimes referred to in marketing as *triple play* service. When these three are offered with cellular service, the combined service may be referred to as *quadruple play*.

Regulation

Historically, cable TV operators have been regulated differently from telecommunication operators. As IPTV allows TV and VOD to be transmitted over the Internet, new regulatory issues arise.[72] Professor Eli M. Noam highlights in his report "TV or Not TV: Three Screens, One Regulation?" some of the key challenges with sector-specific regulation that is becoming obsolete due to convergence in this field.[73]

See also

- Content delivery network
- DVB-IPTV
- Hybrid Broadcast Broadband TV
- Over-the-top media service
- P2PTV
- SAT>IP
- Software as a service
- Streaming television

Notes

a. South Korea, for instance, has 6 million homes benefiting from a minimum connection speed of 100 Mbit/s.

b. For VOD, the stream is delivered using unicast whereas IPTV typically uses multicast.

References

1. Jackson, Mark (22 August 2021). "Sky UK Allegedly Trial Broadband TV Service Without Satellite UPDATE" (https://www.ispreview.co.uk/index.php/2021/08/sky-uk-allegedly-trial-broadband-tv-service-without-satellite.html) . *ISPreview UK*. Retrieved 1 July 2024.
2. Ferguson, Andrew (November 2005). "IPTV the new buzz word in the UK broadband industry" (https://www.thinkbroadband.com/news/2149-iptv-the-new-buzz-word-in-the-uk-broadband-industry) . *Think Broadband*.
3. Sharma, Ashok. "What is IPTV" (https://www.engineersgarage.com/what-is-iptv/) . *Engineers Garage*. Retrieved 1 July 2024.

4. Moro-Visconti, Roberto (17 April 2021). *Startup Valuation: From Strategic Business Planning to Digital Networking* (https://books.google.com/books?id=NiMqEAAAQBAJ&dq=OTT+also+encompasses+a+wave+of+%22skinny%22+television+services&pg=PA310) . Springer. ISBN 9783030716080.
5. "Login Page" (https://docbox.etsi.org/zArchive/TISPAN/Open/Information/NGN_Presentations/IPTV%20Asia%20Dec08/Boswarthick_for_IPTV_Asia_Dec08.pdf) (PDF).
6. "Japan standardisation for IPTV services" (https://advanced-television.com/2008/06/26/japan-standardisation-for-iptv-services/) . 26 June 2008. Retrieved 1 July 2024.
7. "IPTV overtakes pay satellite TV in Western Europe" (https://www.broadbandtvnews.com/2016/04/12/iptv-overtakes-pay-satellite-tv-in-western-europe/) . *Broadband TV News*. 12 April 2016. Retrieved 1 July 2024.
8. "IPTV Standardization on Track Say Industry Experts" (https://web.archive.org/web/20110916031736/http://www.itu.int/ITU-T/newslog/IPTV+Standardization+On+Track+Say+Industry+Experts.aspx) . *ITU-T Newslog*. 27 October 2006. Archived from the original (http://www.itu.int/ITU-T/newslog/IPTV+Standardization+On+Track+Say+Industry+Experts.aspx) on 16 September 2011. Retrieved 17 January 2012.
9. "ATIS IPTV Exploratory Group Report and Recommendation to the TOPS Council" (http://www.atis.org/tops/IEG/ATIS_IPTV_EG_RPT_final.pdf) (PDF). Alliance for Telecommunications Industry Solutions. July 2006. Archived (https://web.archive.org/web/20120118031705/http://www.atis.org/tops/IEG/ATIS_IPTV_EG_RPT_final.pdf) (PDF) from the original on 18 January 2012. Retrieved 17 January 2012. `{{cite journal}}`: Cite journal requires `|journal=` (help)
10. Lea, William (1994). *Video on demand: Research Paper 94/68* (https://web.archive.org/web/20190920082623/https://researchbriefings.parliament.uk/ResearchBriefing/Summary/RP94-68) . House of Commons Library. Archived from the original (https://researchbriefings.parliament.uk/ResearchBriefing/Summary/RP94-68) on 20 September 2019. Retrieved 20 September 2019.
11. Ghanbari, Mohammed (2003). *Standard Codecs: Image Compression to Advanced Video Coding* (https://books.google.com/books?id=7XuU8T3ooOAC&pg=PA1) . Institution of Engineering and Technology. pp. 1–2. ISBN 9780852967102.
12. Li, Jian Ping (2006). *Proceedings of the International Computer Conference 2006 on Wavelet Active Media Technology and Information Processing: Chongqing, China, 29-31 August 2006* (https://books.google.com/books?id=FZiK3zXdK7sC&pg=PA847) . World Scientific. p. 847. ISBN 9789812709998.

13. "Summary of Acquisitions" (https://web.archive.org/web/20070821101009/http://www.cisco.com/warp/public/750/acquire.html) . Cisco. Archived from the original (http://www.cisco.com/warp/public/750/acquire.html) on 21 August 2007.

14. Gonderinger, Lisa. "US West quietly leads digital cable market" (https://web.archive.org/web/20200608194045/https://www.newspapers.com/clip/53045931/arizona-republic/) . *The Arizona Republic*. No. 20 May 1998. Archived from the original (https://www.newspapers.com/clip/53045931/arizona-republic/) on 8 June 2020. Retrieved 8 June 2020.

15. "FIFTH ANNUAL REPORT" (https://transition.fcc.gov/Bureaus/Cable/Reports/fcc98335.pdf) (PDF). Federal Communications Commission. Archived (https://web.archive.org/web/20111021044229/https://transition.fcc.gov/Bureaus/Cable/Reports/fcc98335.pdf) (PDF) from the original on 21 October 2011. Retrieved 8 June 2020.

16. O'Shea, Dan (10 October 2008). "Qwest finally phasing out Choice TV" (https://web.archive.org/web/20200608194647/https://www.fiercevideo.com/cable/qwest-finally-phasing-out-choice-tv) . *FierceVideo*. Archived from the original (https://www.fiercevideo.com/cable/qwest-finally-phasing-out-choice-tv) on 8 June 2020. Retrieved 8 June 2020.

17. Hart, Timothy (15 February 1998). "KCTU-TV earns a place in television, Internet history" (http://wichita.bizjournals.com/wichita/stories/1998/02/16/focus1.html) . Archived (https://web.archive.org/web/20070307224214/http://wichita.bizjournals.com/wichita/stories/1998/02/16/focus1.html) from the original on 7 March 2007.

18. "Kingston pulls plug on IPTV service" (https://www.theregister.co.uk/2006/02/27/kingston_iptv/) . *theregister.co.uk*. Archived (https://web.archive.org/web/20171113031558/http://www.theregister.co.uk/2006/02/27/kingston_iptv/) from the original on 13 November 2017. Retrieved 25 April 2018.

19. KIT Kingston Interactive Television (http://www.kitv.co.uk/) Archived (https://web.archive.org/web/20150905163612/http://www.kitv.co.uk/) 5 September 2015 at the Wayback Machine. Kitv.co.uk. Retrieved on 12 March 2014.

20. "NBTel leading the way in North America with Aliant's new interactive information and entertainment television service – VibeVision" (http://www.bce.ca/en/news/releases/aliant/2000/01/24/53.html) (Press release). Archived (https://web.archive.org/web/20090122222013/http://www.bce.ca/en/news/releases/aliant/2000/01/24/53.html) from the original on 22 January 2009.

21. "Bruncor launches ImagicTV" (https://web.archive.org/web/20181008022723/https://www.thefreelibrary.com/Bruncor+launches+ImagicTV-a020767197) . *www.thefreelibrary.com* (Press release). 9 June 1998. Archived from the original (http://www.thefreelibrary.com/Bruncor+launches+ImagicTV-a020767197) on 8 October 2018. Retrieved 25 April 2018.

22. "Aliant Telecom Launches New Television Technology in Halifax" (https://web.archive.org/web/20080617041001/http://www.bce.ca/en/news/releases/aliant/2001/08/30/6317.html) (Press release). Archived from the original (http://www.bce.ca/en/news/releases/aliant/2001/08/30/6317.html) on 17 June 2008.

23. "Alcatel Acquires iMagic TV" (http://www.itbusiness.ca/news/alcatel-buys-imagic-to-conjure-digital-tv-over-dsl/1852) . *ITBusiness.ca*. 2003. Archived (https://web.archive.org/web/20160914082455/http://www.itbusiness.ca/news/alcatel-buys-imagic-to-conjure-digital-tv-over-dsl/1852) from the original on 14 September 2016. Retrieved 7 October 2018.

24. "Lucent Technologies Introduces First Commercial IP Video Over DSL Solution, Business Net" (https://web.archive.org/web/20130606140015/http://findarticles.com/p/articles/mi_m0EIN/is_2002_April_10/ai_84632001) . *Business Wire*. 10 April 2002. Archived from the original (http://findarticles.com/p/articles/mi_m0EIN/is_2002_April_10/ai_84632001) on 6 June 2013. Retrieved 4 February 2008.

25. "Amino selected for first HD IPTV deployment in USA" (https://web.archive.org/web/20160827060454/https://investor.aminocom.com/story-EMQ1314) . Archived from the original (https://investor.aminocom.com/story-EMQ1314) on 27 August 2016. Retrieved 16 August 2016.

26. "Bredbandsbolaget rustar på ip-tv" (https://web.archive.org/web/20090227031108/http://www.idg.se/2.1085/1.203998/bredbandsbolaget-rustar-pa-ip-tv) [Bredbandsbolaget is mobilizing for IP TV] (in Swedish). Archived from the original (http://www.idg.se/2.1085/1.203998/bredbandsbolaget-rustar-pa-ip-tv) on 27 February 2009.

27. "TPG IPTV Officially Launched! - TPG" (https://forums.whirlpool.net.au/archive/760306) . *Whirlpool.net.au*. Retrieved 1 June 2023.

28. "TPG - IPTV" (https://web.archive.org/web/20070703020725/http://www.tpg.com.au/iptv/index.php) . 13 March 2023. Archived from the original (https://www.tpg.com.au/iptv/index.php) on 3 July 2007. Retrieved 1 June 2023.

29. "Internet Providers - Compare Broadband Deals from 44 Providers - WhistleOut" (https://web.archive.org/web/20120303102927/http://broadband.theage.com.au/Broadband/Providers) . *broadband.theage.com.au*. Archived from the original (http://broadband.theage.com.au/Broadband/Providers/) on 3 March 2012. Retrieved 25 April 2018.

30. "CenturyLink Quietly Launches Prism IPTV Product" (http://www.telecompetitor.com/centurylink-quietly-launches-prism-iptv-product/) . Telecompetitor.com. Archived (https://web.archive.org/web/20170706231505/http://www.telecompetitor.com/centurylink-quietly-launches-prism-iptv-product/) from the original on 6 July 2017. Retrieved 15 June 2013.

31. "Bell Fibe TV launches in Toronto and Montréal" (https://www.bce.ca/news-and-media/releases/show/bell-fibe-tv-launches-in-toronto-and-montr-al) . *www.bce.ca*. Retrieved 25 June 2022.

32. "Fibe TV - Home | Bell Canada" (https://www.bell.ca/Fibe-TV) . *www.bell.ca*. Retrieved 25 June 2022.

33. "IPTV Global Forecast (2008–2013)" (https://web.archive.org/web/20100601051235/http://www.international-television.org/tv_market_data/global-iptv-forecast-2009-2013.html) . International Television Expert Group. Archived from the original (http://www.international-television.org/tv_market_data/global-iptv-forecast-2009-2013.html) on 1 June 2010.

34. "Orange consacré "Meilleur réseau mobile" au Maroc" (https://lematin.ma/journal/2018/orange-consacre-meilleur-reseau-mobile-maroc/302109.html) . *Le Matin* (in French). 5 October 2018. Retrieved 11 October 2019.

35. "BH Telecom: BH Telecom - početna" (https://www.bhtelecom.ba/portalnovost+M5c30c4559cc.html) . *www.bhtelecom.ba*. Archived (https://web.archive.org/web/20170629193910/http://www.bhtelecom.ba/portalnovost+M5c30c4559cc.html) from the original on 29 June 2017. Retrieved 25 April 2018.

36. "Interactieve TV - Wat is Interactieve TV? - KPN" (http://www.kpn.com/tv.htm) . *www.kpn.com*. Archived (https://web.archive.org/web/20091206083324/http://www.kpn.com/tv.htm) from the original on 6 December 2009. Retrieved 25 April 2018.

37. T-Home.hu (http://www.t-home.hu/lakossagi/tv/iptv) Archived (https://web.archive.org/web/20090917024737/http://www.t-home.hu/lakossagi/tv/iptv) 17 September 2009 at the Wayback Machine

38. InviTV.hu (http://www.invitv.hu/)

39. "UZONLINE - Тарифы на Интернет" (https://web.archive.org/web/20180112172142/http://uzonline.uz/ru/services/internet/#iptv_f) . *uzonline.uz*. Archived from the original (http://uzonline.uz/ru/services/internet/#iptv_f) on 12 January 2018. Retrieved 25 April 2018.

40. "Media + Networks" (https://web.archive.org/web/20090722095603/http://www.iptv-news.com/iptv_news/february_09/bt_vision_passes_398k_subs_in_4q08) . *www.iptv-news.com*. Archived from the original (http://www.iptv-news.com/iptv_news/february_09/bt_vision_passes_398k_subs_in_4q08) on 22 July 2009. Retrieved 25 April 2018.

41. "Salad days," (http://www.broadbandtvnews.com/?p=4685) Archived (https://web.archive.org/web/20080503153512/http://www.broadbandtvnews.com/?p=4685) 3 May 2008 at the Wayback Machine Chris Dziadul, *Broadband TV News,* 2 May 2008

42. Delivering IPTV System to Kazakhtelecom (http://www.iptv-industry.com/ar/23i.htm) Archived (https://web.archive.org/web/20091110000552/http://www.iptv-industry.com/ar/23i.htm) 10 November 2009 at the Wayback Machine Article from the IPTV industrial portal

43. iD TV services for broadband subscribers in Kazakhstan (http://www.telecom.kz/index.php?actn=home&uin=1240830886&lang=eng) Archived (https://web.archive.org/web/20111008005028/http://www.telecom.kz/index.php?actn=home&uin=1240830886&lang=eng) 8 October 2011 at the Wayback Machine Kazakhtelecom JSC – iD TV service for Home users

44. iiNet's Age of Terabyte (http://www.iinet.net.au/press/releases/20100818-iinet-age-of-terabyte-arrives.pdf) Archived (https://web.archive.org/web/20101010194736/http://www.iinet.net.au/press/releases/20100818-iinet-age-of-terabyte-arrives.pdf) 10 October 2010 at the Wayback Machine PDF from iiNet press release 18 August 2010

45. "PLDT HOME leads fixed broadband market, adds six times more subscribers than competition" (http://www.pldt.com/news-center/article/2016/05/25/pldt-home-leads-fixed-broadband-market-adds-six-times-more-subscribers-than-competition) . PLDT Incorporated. 25 May 2016. Archived (https://web.archive.org/web/20160529083030/http://www.pldt.com/news-center/article/2016/05/25/pldt-home-leads-fixed-broadband-market-adds-six-times-more-subscribers-than-competition) from the original on 29 May 2016. Retrieved 17 February 2016.

46. "High Speed Fiber Optic Internet Connection | PLDT HOME" (http://pldthome.com/fibr) . Archived (https://web.archive.org/web/20170126161218/http://pldthome.com/fibr) from the original on 26 January 2017. Retrieved 17 February 2017.

47. "Turkey's iptv, Tivibu Ev is on air" (http://www.ntvmsnbc.com/id/25185594/) *ntvmsnbc.com*, 23 February 2011.

48. "Tivibu Ev's Official Homepage" (http://www.tivibu.com.tr/ev) *tivibu.com/ev*, 13 March 2011. Archived (https://web.archive.org/web/20110224193159/http://www.tivibu.com.tr/ev) 24 February 2011 at the Wayback Machine

49. "inwf.com" (http://www.inwf.com/pubs/print/aroc58_toc.html) . *www.inwf.com*. Archived (https://web.archive.org/web/20161222175000/http://www.inwf.com/pubs/print/aroc58_toc.html) from the original on 22 December 2016. Retrieved 25 April 2018.

50. SmartGridToday.com. "5 stories in 2 minutes" (http://www.smartgridtoday.com/public/873.cfm) . *www.smartgridtoday.com*. Archived (https://web.archive.org/web/20120310084013/http://www.smartgridtoday.com/public/873.cfm) from the original on 10 March 2012. Retrieved 25 April 2018.

51. HomeGrid Forum Blog – Why do we need a unified standard at all? (http://homegridforum.typepad.com/homegrid_forum/2008/10/why-do-we-need-a-unified-standard-at-all-1.html) Archived (https://web.archive.org/web/20090622050023/http://homegridforum.typepad.com/homegrid_forum/2008/10/why-do-we-need-a-unified-standard-at-all-1.html) 22 June 2009 at the Wayback Machine

52. New global standard for fully networked home (http://www.itu.int/ITU-T/newslog/New+Global+Standard+For+Fully+Networked+Home.aspx) Archived (https://web.archive.org/web/20090221090736/http://www.itu.int/ITU-T/newslog/New+Global+Standard+For+Fully+Networked+Home.aspx) 21 February 2009 at the Wayback Machine, ITU-T Press Release

53. Quasar POF alliance (http://www.quasar-pof.com/) Archived (https://web.archive.org/web/20160110053730/http://quasar-pof.com/) 10 January 2016 at the Wayback Machine

54. "Search & Browse Standards" (http://pda.etsi.org/pda/home.asp?wki_id=CaDXV0CcRxTVYVVcl3FyX) . *pda.etsi.org*. Archived (https://web.archive.org/web/20130728042738/http://pda.etsi.org/pda/home.asp?wki_id=CaDXV0CcRxTVYVVcl3FyX) from the original on 28 July 2013. Retrieved 25 April 2018.

55. "IMS-based IPTV services – architecture and implementation" (http://www.staff.city.ac.uk/~veselin/publications/Sivchenko_ACM07.pdf) (PDF). *city.ac.uk*. Archived (https://web.archive.org/web/20160417235527/http://www.staff.city.ac.uk/~veselin/publications/Sivchenko_ACM07.pdf) (PDF) from the original on 17 April 2016. Retrieved 25 April 2018.

56. Berlocher, Greg and Freyer, Dan. "IP And Satellite: Communications Worlds Merging" *Via Satellite* January 2009 p 24–28

57. Taga, Karim. "Hybrid delivery of content for IPTV" *InterComms* Issue 11 August 2008 p 13–14

58. Holmes, Mark (September 2008). "Broadcast 2.0: The Changing Scene In Europe" (https://www.satellitetoday.com/broadcasting/2008/09/01/broadcast-2-0-the-changing-scene-in-europe/) . *Via Satellite*. pp. 20–25.

59. 19.46 Europe/London (14 October 2009). "UK and France lead with hybrid IPTV set-tops" (http://www.broadbandtvnews.com/2009/10/14/uk-and-france-lead-with-hybrid-iptv-set-tops/) . Broadbandtvnews.com. Archived (https://web.archive.org/web/20130728021919/http://www.broadbandtvnews.com/2009/10/14/uk-and-france-lead-with-hybrid-iptv-set-tops/) from the original on 28 July 2013. Retrieved 15 June 2013.

60. [1] (http://www.mrgco.com/press_releases.html#hstb09) Archived (https://web.archive.org/web/20100402135703/http://www.mrgco.com/press_releases.html#hstb09) 2 April 2010 at the Wayback Machine

61. "HYBRID Set Top Boxes for IPTV | Digital Media Strategy by Jeff Vinson" (http://jviptv.wordpress.com/2009/06/25/hybrid-iptv-stb/) . Jviptv.wordpress.com. 25 June 2009. Archived (https://web.archive.org/web/20130719230819/http://jviptv.wordpress.com/2009/06/25/hybrid-iptv-stb/) from the original on 19 July 2013. Retrieved 15 June 2013.

62. [2] (http://www.v-net.tv/Webcast.aspx?id=5) Archived (https://web.archive.org/web/20100405064453/http://www.v-net.tv/Webcast.aspx?id=5) 5 April 2010 at the Wayback Machine

63. "New European initiative merges television with the power of the Internet" (https://web.archive.org/web/20091007125549/http://www.hbbtv.org/news/HBBTV_PR_Final.pdf) (PDF) (Press release). HbbTV Consortium. 27 August 2009. Archived from the original (http://www.hbbtv.org/news/HBBTV_PR_Final.pdf) (PDF) on 7 October 2009.

64. "ADB Delivers World's First Hybrid, Single-Chip, Advanced Video Coding, High Definition IPTV Set-Top Boxes To TELEFÓNICA" (https://web.archive.org/web/20120227141252/http://www.digitaltvnews.net/items/060911adb_spain.htm) . Digitaltvnews.net. Archived from the original (http://www.digitaltvnews.net/items/060911adb_spain.htm) on 27 February 2012. Retrieved 15 June 2013.

65. "IPTV Americas Launches First IPTV Satellite Distribution Platform for Latin America and The Caribbean via SES NEW SKIES' NSS-806" (https://web.archive.org/web/20111016015125/http://www.iptv-americas.tv/releaseDB.php?leng=&notID=47) (Press release). IPTV Americas. 13 January 2009. Archived from the original (http://www.iptv-americas.tv/releaseDB.php?leng=&notID=47) on 16 October 2011.

66. "Broadband Users Control What They Watch and When" (https://web.archive.org/web/20100420143608/http://www.tvgenius.net/blog/2010/04/06/broadband-users-control-watch/) . Archived from the original (http://www.tvgenius.net/blog/2010/04/06/broadband-users-control-watch/) on 20 April 2010.

67. Riede, Christian; Al-Hezmi, Adel; Magedanz, Thomas (12 February 2008). "Session and Media Signalling for IPTV via IMS" (https://web.archive.org/web/20080625075612/http://c-mobile.ptinovacao.pt/files/PaperMobilWare2008.pdf) (PDF). *MobileWare'08*. Innsbruck, Austria. Archived from the original (http://c-mobile.ptinovacao.pt/files/PaperMobilWare2008.pdf) (PDF) on 25 June 2008.

68. Bulkley, Kate. "IPTV's Eastern Promise" *Digital TV Europe* October 2008 p 48

69. Brown, Peter J. "Super Headends And High Expectations" *Via Satellite* April 2006 p 18–30

70. Denis, Lacković (9 March 2020). "Network Requirements for IPTV and OTT Service" (https://www.uniqcast.com/blog/iptv-ott-service-requirements) . *Uniqcast*. Archived (https://web.archive.org/web/20221208124601/https://www.uniqcast.com/blog/iptv-ott-service-requirements) from the original on 8 December 2022. Retrieved 30 April 2023.

71. IPTV privacy risks (http://www.cedmagazine.com/iptv-privacy-risks.aspx) Archived (https://web.archive.org/web/20100105172921/http://www.cedmagazine.com/iptv-privacy-risks.aspx) 5 January 2010 at the Wayback Machine

72. "Ericsson report on need for regulation" (http://www.ericsson.com/ericsson/corpinfo/publications/ericsson_business_review/pdf/308/308_38_41_reshaping.pdf) (PDF). Archived (https://web.archive.org/web/20081115174848/http://www.ericsson.com/ericsson/corpinfo/publications/ericsson_business_review/pdf/308/308_38_41_reshaping.pdf) (PDF) from the original on 15 November 2008. (217 KB)

73. (CRTC), Government of Canada, Canadian Radio-television and Telecommunications Commission (3 September 2008). "TV or Not TV: Three Screens, One Regulation?" (http://www.crtc.gc.ca/eng/media/noam2008.htm) . *www.crtc.gc.ca*. Archived (https://web.archive.org/web/20171213034731/http://www.crtc.gc.ca/eng/media/noam2008.htm) from the original on 13 December 2017. Retrieved 25 April 2018.

Further reading

- Anderson, Nate (12 March 2006). "An Introduction to IPTV" (https://arstechnica.com/guides/other/iptv.ars) . *Ars Technica*.